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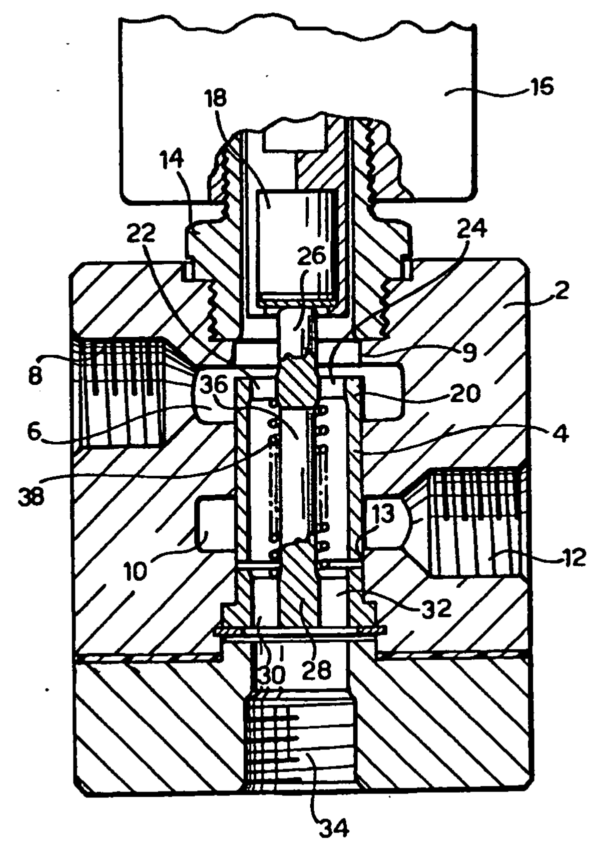
(71) Applicants
Fiat Società per Azioni,
Corso Marconi 10, Turin,
Italy
(72) Inventors
Luciano Moretti
(74) Agents
F. J. Cleveland &
Company

(54) Improvements in or Relating to Three-Way Valves

(57) A three-way valve comprising a body 2 and a bore 4 having, towards each end, a chamber 6, 10 in communication with supply or exhaust connections 8, 12, in which a spring-loaded two-position hollow spool 20, slidable in the bore, can connect a load connection 34 with the supply or exhaust by opening or blocking one of the chambers in each position of the spool. The spool is moved into its alternative positions by an electromagnet 16.

FIG. 1



GB 2 008 230 A

FIG. 1

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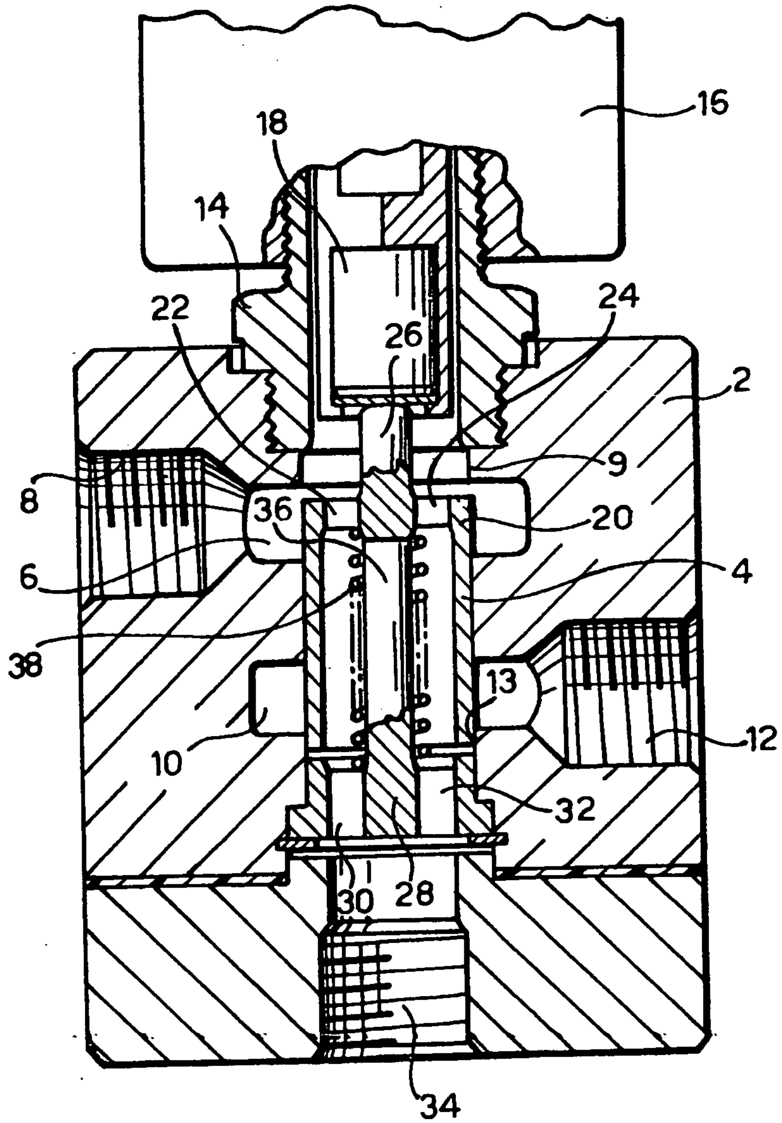


FIG. 2

2008230

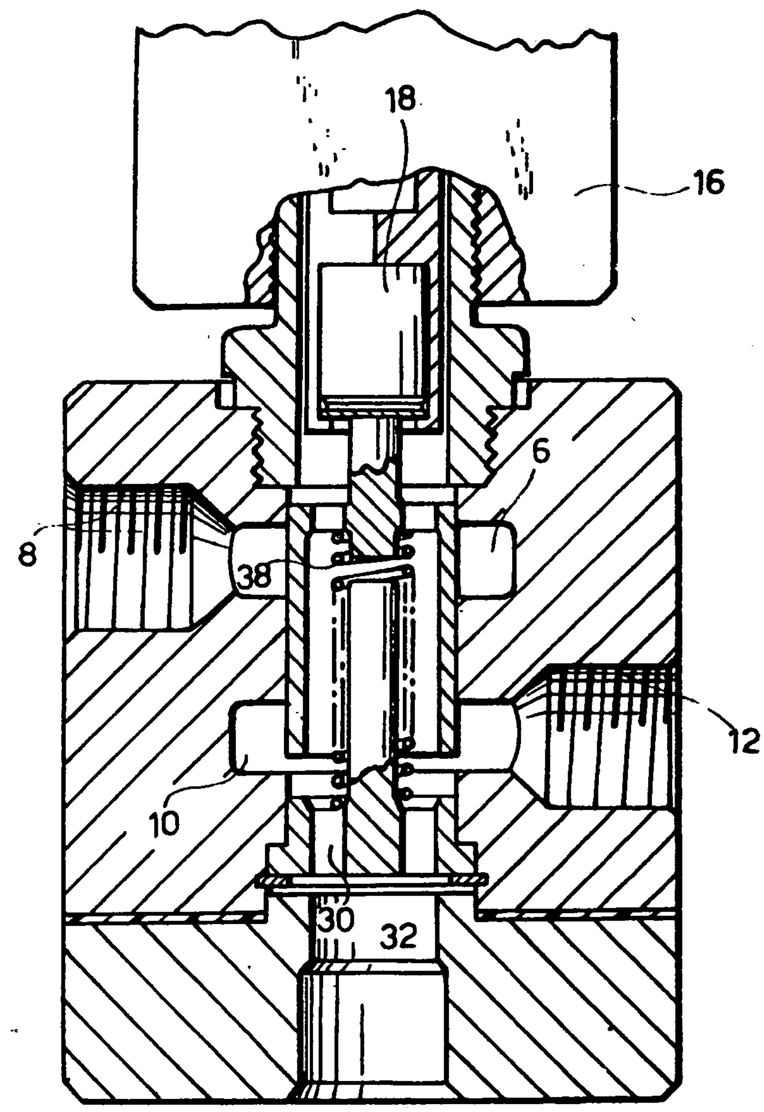
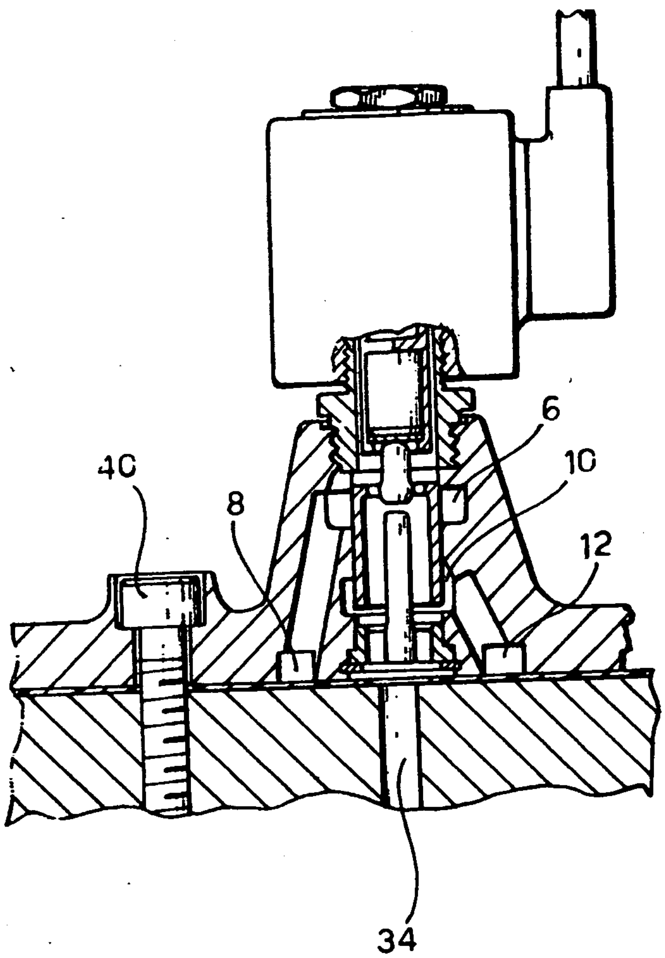


FIG. 3



SPECIFICATION

Improvements in or Relating to Servo-Operated Three-Way Valves

The present invention relates to servo-operated three-way valves. More particularly, the invention concerns three-way valves of the kind comprising a body with supply, exhaust and load connections, a bore in which a spring-loaded spool is slidably and sealingly housed and servo operator means for moving the spool between first and second operative positions in said valve. Such valves may be employed in hydraulic or other fluid pressure circuits.

Valves of the above specified type are currently used in diverse equipment but they require a high power input, in relation to their useful flow cross-section, for effecting changeover from one state to another. A further disadvantage is that these valves must be dismantled for internal modification before they can be used in a mode different from their normal, that is, either normally-closed or normally-open, mode.

The object of the present invention is to provide a valve of the above specifed type which can be controlled with limited electric power and which can be used in either the normally-closed or normally-open mode without requiring internal modification.

The present invention provides a servo-operated three-way valve comprising a body with supply, exhaust and load connections, a bore in which a spring-loaded spool is slidably and sealingly housed and servo operator means for moving the spool between first and second operative positions in said valve, characterised in that the said bore has at opposite ends first and second chambers respectively, and the said spool has an internal cavity having an open end communicating with the said second chamber in the second operative position of the valve and cut off from said second chamber in the first operative position of the valve, the other end of the spool being closed and having at least one throughport for connecting the said internal cavity with the said first chamber in the first operative position of the valve, the first chamber being cut-off from the internal cavity in the second operative position of the valve.

In the preferred embodiment the valve has an electromagnetically actuated servo-control, however other means of actuation may be used, such as, for example, hydraulic, pneumatic or mechanical.

The valve may be connected to the circuit in which it is to be included by either connectors and/or pipes or a terminal board.

The present invention will now be more particularly described, by way of example, with reference to the accompanying drawings, in which:

Figure 1 is an axial section of an hydraulic valve according to one embodiment of the invention with a servo-operating electromagnet de-energised;

Figure 2 is the same axial section with the servo-operating electromagnet energised; and

Figure 3 shows an alternative embodiment of the invention, in axial section, mounted on a terminal board.

In Figure 1, there is shown a body 2 of a valve which has a central axial through-bore 4 made in such a way as to form a first annular chamber 6, communicating with a first connection 8, having above it a first land 9 which is a continuation of the bore 4. The bore 4 is also formed with a second annular chamber 10, communicating with a second connection 12, having below it a second land 13 which is also a continuation of the bore 4. The body 2 has on its upper face a threaded seating in which is screwed an adaptor 14 for connection to servo-operator means, in this case an electromagnet 16, the central core 18 of which is partially visible.

A hollow spool 20 is slidably and sealingly housed in the bore 4 and has an open lower end which can slide into the second land 13, as shown in Figure 1. The upper end of the spool 20, which is closed by an end wall, can slide into the first land 9, as shown in Figure 2. The end wall is formed with a set of through-ports, two of which 22, 24 are shown, which connect the hollow interior of the spool 20 with the first chamber 6 in the first operative position of the valve (Figure 1). An appendage 26 which extends from the upper end of the spool 20 is in contact with the core 18 of the electromagnet 16.

The lower face of the valve body 2, which has a seating which supports a plug 28, is traversed in an axial direction by a set of passage-ports, two of which 30, 32 are shown in Figure 1. These passage-ports 30, 32 serve to connect a third connection 34 with the hollow part of the spool 20 and thus with the upper chamber 6 by means of the through-ports 22 and 24. In Figure 2 the ports 30, 32 join the connection 34 with the lower chamber 10.

The plug 28 supports a stop element comprising a stem 36 which extends coaxially through the spool cavity and is adapted to restrict the downward travel of the spool 20 and to serve as a guide for a biassing spring 38 which coaxially surrounds the stem 36.

The valve can be used in either the normally-closed or normally-open mode. In the first case the connection 8 is connected to the exhaust and the connection 12 is connected to the supply. In both cases the connection 34 is connected to a load.

The operation of the valve in the normally-closed mode is as follows: as shown in Figure 1 the valve is in the first operative position with the electromagnet 16 de-energised so that its biassing spring (not shown) thrusts the core 18 downwards pushing the spool 20 into contact with the upper end of the stem 36 compressing the spring 38. This action cuts off the flow of a fluid, which, coming from the supply connection

12, enters the annular chamber 10, outflow from which is blocked by the spool 20. In this case the fluid, which had actuated the load in a previous cycle, is diverted to the exhaust by passing from the load connection 34, through the ports 30, 32, into the internal cavity of spool 20, through the ports 22, 24 and the upper chamber 6, which is left open due to the downward displacement of the spool 20, and out through the connection 8 into the exhaust.

When the electromagnet is energised in the second operative position of the valve, as shown in Figure 2, the core 18 is displaced upwards, compressing the biassing spring of the magnet, and in consequence the spool 20, not being restrained by the core, is thrust in an upward direction by the extension of the spring 38. This results in closing of the first annular chamber 6 and opening of the second annular chamber 10, so that the fluid coming from the supply connection 12 can pass through the ports 30, 32 and out through the load connection 34.

To use the valve in the normally-open mode one simply interchanges the feed connection with the exhaust connection so that, referring to the given reference numerals, the supply connection 12 becomes the exhaust, and the exhaust connection 8 becomes the supply.

The operation of the valve in the normally-open mode is as follows: as shown in Figure 1, the magnet 16 is de-energised so that the core 18 is thrust downwards by the biassing spring, the spool 20 is also thrust downwards, compressing the spring 38, until it is stopped against the upper end of the stem 36. Thus, the flow of fluid from the feed connection 8 enters the annular chamber 6 and, by passing through the area left open by the downward displacement of the spool 20, flows through the ports 22, 24 into the spool 20 from where, by passing through the ports 30, 32 and the connection 34, it reaches the load.

When, as shown in Figure 2, the magnet 16 is energised the core 18 is displaced upwards, compressing the biassing spring of the magnet. The pressure on the spool 20 is released and this is also thrust upwards by the spring 38 to block the fluid coming from the feed connection 8, while at the same time opening the chamber 10, through which the fluid, coming from the load connection 34 and passing through the ports 30, 32, enters the exhaust connection 12.

Since the spool 20 is provided with through-ports 22, 24 and, therefore, with low resistance sections, each displacement is accomplished rapidly using limited electric power because the spool 20 is displaced while immersed in the fluid it is controlling, and is therefore pressure-balanced.

In Figure 3, which shows an embodiment of the valve for mounting on a terminal board, the valve body 2 has a different form from that previously described. The connections 8 and 12, which communicate with chamber 6 and 10 respectively, are machined in the body 2 in a direction which is substantially parralel to the bore of the valve body. The basic operation of the valve is unchanged. In this case if it is wished to change the mode of operation of the valve from normally-closed to normally-open it is only necessary to remove the screws 40 and rotate the valve through 180°, with respect to the holes used for fixing the valve when it is in use.

Claims

1. A servo-operated three-way valve comprising a body with supply, exhaust and load connections, a bore in which a spring-loaded spool is slidably and sealingly housed and servo operator means for moving the spool between first and second operative positions in said valve, charactersied in that the said bore has at opposite ends first and second chambers respectively, and the said spool has an internal cavity having an open end communicating with the said second chamber in the second operative position of the valve and cut off from said second chamber in the first operative position of the valve, the other end of the spool being closed and having at least one through-port for connecting the said internal cavity with the said first chamber in the first operative position of the valve, the first chamber being cut-off from the internal cavity in the second operative position of the valve.

2. Valve as claimed in Claim 1, characterised in that the said chambers communicate with supply and exhaust connections of the valve.

3. Valve as claimed in Claim 1, characterised in that the said cavity communicates permanently with the load connection through the open end of the spool.

4. Valve as claimed in Claim 1, characterised in that the valve body is provided with a stop element which extends coaxially in the internal cavity of the spool to engage the spool in one of the operative positions of the valve.

5. Valve as claimed in Claim 4, characterised in that a biasing spring coaxially surrounds the stop element and biasses the spool towards one operative position of the valve.

6. Valve as claimed in Claim 1, characterised in that the connections in the valve body terminate in one face of the body, adapted to be mounted on a flat surface for communication with ports in said surface, the communication between the connections and the ports being interchangeable by a rotation of the valve body relative to said surface.

7. Valve substantially as herein described with reference to and as shown in the accompanying drawings.

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